

REPLACED BY
ART 34 AMDT**CLAIMS**

1. A process for the manufacture of a catalyst which process comprises;
 - a) preparing a support having one or more organic complexes of one or more catalytically active metals deposited thereon;
 - b) partially decomposing the one or more organic metal complexes deposited thereon; and
 - c) converting the one or more partially decomposed organic metal complexes into catalytically active metal.
2. A process for the manufacture of a catalyst which process comprises;
 - a) treating a porous support with a compound, or salt, of one or more catalytically active metals to provide a porous support with one or more catalytic metal precursors deposited thereon,
 - b) treating the support with one or more catalytic metal precursors deposited thereon with one or more organic compounds to form one or more organic complexes,
 - c) partially decomposing the one or more organic complexes; and
 - d) converting the one or more partially decomposed organic metal complexes into catalytically active metal.
3. A process according to claim 2 wherein the support with one or more catalytic metal precursors deposited thereon of step a) is thermally treated by calcination or pyrolysis prior to the treatment of step b).
4. A process for the manufacture of a catalyst which process comprises;
 - a) treating a porous support with one or more organic compounds,
 - b) treating the support with one or more organic compounds deposited thereon with a compound, or salt, of one or more catalytically active metals to form one or more organic complexes,
 - c) partially decomposing the one or more organic complexes; and

REPLACED BY
ART 34 AMDT

- d) converting the one or more partially decomposed organic metal complexes into catalytically active metal.

5. A process for the manufacture of a catalyst which comprises;

- 5 a) treating a porous support with a compound, or salt, of one or more catalytically active metals to provide a porous support with one or more catalytic metal precursors deposited thereon,
- b) treating the support with one or more catalytic precursors deposited thereon with one or more organic compounds to form one or more organic complexes,
- 10 c) fully decomposing the one or more organic complexes deposited thereon; and
- d) converting the one or more fully decomposed organic metal complexes into catalytically active metal.

6. A process according to claim 5 wherein the support with one or more catalytic metal precursors deposited thereon of step a) is thermally treated by calcination or pyrolysis prior to the treatment of step b).

7. A process for the manufacture of a catalyst which process comprises;

- 20 a) treating a porous support with one or more organic compounds,
- b) treating the support with one or more organic compounds deposited thereon with a compound, or salt, of one or more catalytically active metals to form one or more organic complexes,
- 25 c) fully decomposing the one or more organic complexes; and
- d) converting the one or more fully decomposed organic metal complexes into catalytically active metal.

8. A process for the manufacture of a catalyst which comprises

- 30 a) preparing a support having one or more organic complexes of one or more catalytically active metals deposited thereon;

REPLACED BY
ART 34 AMDT

- b) fully decomposing the one or more organic metal complexes deposited thereon; and
- c) converting the one or more fully decomposed organic metal complexes into catalytically active metal.

5

9. A process as claimed in any one of the preceding claims wherein the conversion to catalytically active metal is achieved by treatment of the support comprising one or more fully or partially decomposed organic complexes with a reductant.

10

10. A process as claimed in claim 9 wherein the reductant is a source of hydrogen.

11. A process as claimed in claim 9 wherein the reductant is a source of CO.

15

12. A process as claimed in claim 9 wherein the reductant is both a source of hydrogen and CO.

13. A process as claimed in any one of claims 9 to 12 wherein the source of reductant is provided in-situ in a catalysed process.

20

14. A process as claimed in any one of claims 9 to 13 wherein the source of reductant is provided in a catalyst regeneration process.

25

15. A process as claimed in any one of claims 9 to 14 wherein the source of reductant is provided in a catalyst regeneration process or catalyst recycle process associated with a catalysed process.

30

16. A process as claimed in claim 1 or claim 8 wherein the one or more organic complexes have been formed in-situ during the manufacture or synthesis of the support.

REPLACED BY
ART 34 ANDT

17. A process as claimed in claim 1 or claim 8 wherein the one or more organic complexes are formed from components required to form the complex that have been incorporated into or within the support during manufacture or synthesis of the support.

5

18. A process as claimed in any one of claims 2 to 7 wherein step (a) is omitted and the compound from the omitted step (a) has been incorporated into or within the support during its manufacture or synthesis.

10

19. A process according to any one of the preceding claims wherein the organic complex is derived from one or more organic nitrogen containing compounds.

15

20. A process according to claim 19 wherein the one or more organic nitrogen-containing compounds are amines.

21. A process according to claim 20 wherein at least one of the amines is an aliphatic amine.

20

22. A process as claimed in claim 21 wherein at least one of the aliphatic amine contains one or more hydroxyl groups.

23. A process as claimed in claim 22 wherein the amine comprises one or more amines having hydroxyalkyl groups.

25

24. A process as claimed in claim 23 wherein the hydroxyalkyl groups are C₁-C₅₀-hydroxyalkyl, preferably C₁-C₈-hydroxyalkyl, particularly preferably C₁-C₄-hydroxyalkyl groups.

30

REPLACED BY
ART 34 AMDT

25. A process as claimed in claim 24 wherein the hydroxyalkyl groups are selected from one or more of the following groups: hydroxymethyl, 1-hydroxyethyl, 2-hydroxyethyl, 1-hydroxy-n-propyl, 2-hydroxy-n-propyl, 3-hydroxy-n-propyl and 1-hydroxy-methyl-ethyl.

5

26. A process as claimed in claim 25 wherein the hydroxyalkyl group containing nitrogen compound comprises one or more mono-, di-, and tri-, substituted aliphatic hydroxyalkylamines.

10

27. A process as claimed in claim 26 wherein the hydroxyalkylamine comprises one or more of the following amines; methanolamine, di-methanolamine, tri-methanolamine, ethanolamine, di-ethanolamine, tri-ethanolamine, butanolamine, di-butanolamine, tri-butanolamine, propanolamine, di-propanolamine, dimethylethanolamine, di-isopropylethanolamine, methyldiethanolamine, dimethylamino-2-propanol and tri-propanolamine.

15

28. A process according to claim 19 wherein the organic nitrogen-containing compound is one or more amino acids.

20

29. A process as claimed in claim 28 wherein the amino acid is L-arginine.

30. A process according to any one or the preceding claims wherein the treatment to decompose the organic complex is calcination.

25

31. A process as claimed in claim 30 wherein the organic complex is partially decomposed and the calcination temperature is less than the temperature, as determined by TGA in air, at which total weight loss of the organic complex occurs.

30

REPLACED
ART 34 AMDT

32. A process as claimed in claim 31 wherein the calcination temperature is between 200 °C and the temperature at which total weight loss of the organic complex occurs.

5 33. A process as claimed in claim 30 wherein the organic complex is fully decomposed and the calcination temperature is at or above the temperature, as determined by TGA, at which total weight loss of the organic complex occurs.

10 34. A process as claimed in claim 33 wherein the calcination temperature is between the temperature at which total weight loss of the organic complex occurs and 1000°C.

15 35. A process as claimed in any one of claims 1 to 29 wherein the decomposition is undertaken via pyrolysis.

20 36. A process as claimed in claim 35 wherein the organic complex is partially decomposed and the pyrolysis temperature is less than the temperature, as determined by TGA in an inert atmosphere or hydrogen, at which total weight loss of the organic complex occurs.

25 37. A process as claimed in claim 36 wherein the pyrolysis temperature is between 200 °C and the temperature at which total weight loss of the organic complex occurs.

30 38. A process as claimed in claim 35 wherein the organic complex is fully decomposed and the pyrolysis temperature is at or above the temperature, as determined by TGA in an inert atmosphere or under hydrogen, at which total weight loss of the organic complex occurs.

REPLACED BY
ART 34 AMDT

39. A process as claimed in claim 38 wherein the pyrolysis temperature is between the temperature at which total weight loss of the organic complex occurs and 1000°C.

5 40. A process as claimed in any one of claims 1 to 29 wherein the decomposition is performed by introduction of the support comprising one or more organic complexes into a catalysed process.

10 41. A process as claimed in any one of claims 1 to 29 wherein the decomposition is performed by introduction of the support comprising one or more organic complexes into a catalyst regeneration process.

15 42. A process as claimed in any one of claims 1 to 29 wherein the decomposition is performed by introduction of the support comprising one or more organic complexes into a catalyst recycle process.

20 43. A catalyst comprising one or more catalytically active metals deposited on one or more support materials wherein the total metal dispersion is 45% or more and the metal dispersion relating to a strongly chemisorbed component of the total metal dispersion is 20% or greater.

44. A catalyst as claimed in claim 43 wherein the total metal dispersion is 50% or more.

25 45. A catalyst as claimed in claim 44 wherein the metal dispersion relating to a strongly chemisorbed component of the total metal dispersion is 30% or greater.

30 46. A catalyst precursor comprising at least one support material and at least one source of one or more catalytically active metals deposited on the support material, wherein the source of one or more catalytically active

REPLACED BY
ART 34 AMDT

metals is the decomposition product of one or more metal containing organic complexes.

5 47. A catalyst precursor according to claim 46 wherein the decomposition product is obtained from the partial decomposition of one or more metal containing organic complexes.

10 48. A catalyst precursor according to claim 46 or 47 wherein the precursor exhibits dispersion values relating to the strong dispersion component of less than 1%.

49. A catalyst precursor according to claim 48 wherein the dispersion is less than 0.75%.

15 50. A catalyst precursor according to claim 49 wherein the dispersion is less than 0.5%.

51. A catalyst precursor according to claim 50 wherein the dispersion is less than 0.25%.

20 52. A catalyst precursor according to claim 51 wherein the dispersion is 0%.

25 53. A catalyst precursor according to any one of claims 46 to 52 wherein the precursor exhibits one or more infra-red absorption bands between 2100-2200 cm^{-1} that are not present in the pre-decomposed organic complex.

30 54. A catalyst precursor according to any one of claims 46 to 53 wherein the precursor retains between 10 and 95% by weight of the weight attributed to the pre-decomposed organic complex after drying the support with complex formed thereon.

REPLACED BY
ART 34 AMDT

55. A catalyst precursor according to claim 54 wherein between 20 and 75% by weight is retained.

5 56. A catalyst precursor as claimed in claim 55 wherein up to 60% by weight is retained.

57. A catalyst precursor as claimed in claim 56 wherein up to 50% by weight is retained.

10 58. A catalyst precursor according to any one of claims 46 to 57 wherein reduction temperature to form catalytically active metal from the precursor is in excess of the normal reduction temperature required to reduce the fully oxidized metal complex to catalytically active metal.

15 59. A catalyst precursor as claimed in claim 58 wherein the reduction temperature is at least 5% in excess.

60. A catalyst precursor as claimed in claim 59 wherein the reduction temperature is at least 10% in excess.

20 61. A process or catalyst or catalyst precursor as claimed in any one of the preceding claims wherein the catalyst support comprises silica.

25 62. A process or catalyst or catalyst precursor as claimed in claim 61 wherein the silica is amorphous.

30 63. A process or catalyst or catalyst precursor as claimed in any one of claims 1 to 62 wherein at least one of the support materials is one or more ordered mesoporous materials.

REPLACED BY
ART 34 AMDT

64. A process or catalyst or catalyst precursor as claimed in any one of claims 1 to 63 wherein at least one of the support materials is one or more materials that may be synthesized using amphiphilic compounds as directing agents.

5

65. A process or catalyst or catalyst precursor as claimed in any one of claims 1 to 64 wherein the catalyst support comprises one or more macroporous materials.

10

66. A process or catalyst or catalyst precursor as claimed in any one of claims 1 to 65 wherein the catalyst support comprises one or more mixed porosity materials.

15

67. A process or catalyst or catalyst precursor as claimed in claim 66 wherein the mixed porosity material contains mesopores and macropores.

68. A process or catalyst or catalyst precursor as claimed in any one of the preceding claims wherein at least one of the support materials is one or more materials designated as M41S.

20

69. A process or catalyst or catalyst precursor as claimed in claim 68 wherein the support material is MCM-41.

25

70. A process or catalyst or catalyst precursor as claimed in any one of the preceding claims wherein the support comprises alumina.

71. A process or catalyst or catalyst precursor as claimed in claim 70 wherein the support is gamma alumina.

REPLACED BY
ART 34 AMDT

72. A process or catalyst or catalyst precursor as claimed in any one of claims 1 to 71 wherein the support comprises rutile titanium dioxide, anatase titanium dioxide or mixtures thereof.

5 73. A process or catalyst or catalyst precursor as claimed in claim 72 wherein the support further comprises zirconium dioxide.

74. A process or catalyst or catalyst precursor as claimed in any one of the preceding claims wherein the salt or compound of one or more
10 catalytically active metals is a salt or compound of one or more metals selected from the following groups: Group 1 (Group IA) such as Li, Na or K; Group 2 (Group IIA) such as Mg, Ca and Sr; Group 3 (Group IIIA, IIIB) such as Sc, Y and La; Group 4 (Group IVA, IVB) such as Ti, Zr and Hf; Group 5 (Group VA, VB) such as V, Nb and Ta; Group 6 (Group VIA, VIB) such as Cr, Mo and W; Group 7 (Group VIIA, VIIB) such as Mn, Tc, and Re; Groups 8, 9 and 10 (Group VIII, VIIIA) such as Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, and Pt; Group 11 (Group IB) such as Cu, Ag, and Au; Group 12 (Group IIB) such as Zn; Group 13 (Group IIIA, IIIB) such as Ga and In; and Group 14 (Group IVA, IVB) such as Ge and Sn.

20 75. A process or catalyst or catalyst precursor as claimed in claim 74 wherein the salt or compound of one or more catalytically active metals is a salt or compound of one or more of the following metals; copper, platinum, rhodium, palladium, cobalt, iron, nickel, rhenium, ruthenium or a mixture
25 of two or more thereof as active metal.

76. A catalyst or adsorbent obtainable by the process of any one of claims 1 to 42 or 61 to 75 or via the precursor of any one of claims 46 to 60.

30 77. A process for the production of C₅+ liquid hydrocarbons from a hydrogen and carbon monoxide synthesis gas by contact of the said gas at reaction

conditions with a catalyst, wherein the catalyst is a catalyst as claimed in any one of claims 43 to 45 or claim 76 or as manufactured by the process as claimed in any one of claims 1 to 42 or 61 to 75.

REPLACED BY
ART 34 AMDT

- 5 78. A method for the removal of sulfur from a mixture comprising one or more organic compounds and one or more sulfur containing compounds, in which method the mixture is contacted with one or more materials comprising active metal dispersed on an inorganic support under such conditions that sulfur is adsorbed onto the material comprising active
- 10 metal dispersed on an inorganic support and wherein the material comprising active metal deposited on a support is a catalyst as claimed in any one of claims 43 to 45 or claim 76 or as manufactured by the process as claimed in any one of claims 1 to 42 or 61 to 75.

15